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The role of the mantle in Variscan post-collisional magmatism – insights from Muntele Mic and Culmea Cernei plutons (Romanian Southern Carpathians)

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The Danubian domain of the Romanian Southern Carpathians corresponds to the lowest nappe system pertaining to the Alpine stack and it is composed of pre-Alpine basement assemblages covered by low-grade Mesozoic metamorphic rocks. The pre-Alpine components of the Danubian terranes are two continental fragments of Avalonian origin (the Lainici-Păiuș and Drăgșan) sutured by the Tișovița-Iuți ophiolite complex. Both basement terranes are heavily intruded by granitoid plutons, some of them dated as late Carboniferous to early Permian [1,3]. While significant progress has been achieved in dating the emplacement of Variscan plutons [1,2,3] intruding the Neoproterozoic basement of the Danubian domain (Romanian Southern Carpathians), little work has been carried out in understanding the processes and sources that led to the formation of these plutons.

We present new geochemical and geo-thermometry data for two of the Danubian Variscan plutons (Muntele Mic and Culmea Cernei, of 326±5 Ma and 286±2.9 Ma, respectively – zircon U/Pb age data[1,3]) that help constrain their sources as well as tectonic setting. Muntele Mic (MM) and Culmea Cernei (CC) are two relatively small granitoid bodies intruding both of the Danubian basement terranes. CC is a composite pluton with lithologies ranging from hornblende-granodiorite to (hornblende)biotite-granite and diorite, while MM is composed mainly of biotite-hornblende granodiorite and subordinate biotite-granite. Both plutons are metaluminous to peraluminous. CC granitoids have calc-alkaline affinities, while MM is high-K calc-alkaline (with some shoshonitic samples). MM granitoids have overall lower ΣREE (ranging from 550 to 746 ppm) and less fractionated, concave upward chondrite-normalized REE trends (LaN/YbN from 5 to 9.5). CC samples have higher ΣREE (720 to 1150), more fractionated REE patterns (LaN/YbN from 10 to 14.5) and show little evidence in their patterns for the involvement of amphibole. Modest differences in their Eu/Eu* ratios (average of 0.67 for MM and 0.84 for CC), indicate that feldspar fractionation effects were somewhat different in the two plutons.

Radiogenic (on bulk-rock) and stable isotope (on quartz separates) data for these two plutons support chemically distinct source regions. Overall, MM granitoids have lower 87Sr/86Sr (average of 0.70769), 143Nd/144Nd (average of 0.51233), and δ18O (7.1‰ values (CC averages: 87Sr/86Sr: 0.70917, 143Nd/144Nd: 0.51240, and δ18O: 8.9‰ arguing for the involvement of strongly unradiogenic and possibly mantle-derived components in the MM protolith, and of more crustal sources for the CC protolith. Ti-in-quartz thermometry yielded higher temperatures in the MM pluton (775 to 810°C) compared to the CC pluton (680 to 750°C).

The involvement of mantle suggested by these geochemical data, in plutons emplaced at two distinct moments in the Variscan orogeny within the Danubian domain, argues that the mantle is a significant player in the post-collisional magmatism, and those delamination scenarios that juxtapose mantle and crustal components may be more common than traditionally believed. Alternatively, the hypothesis of extreme fractionation of metasomatically enriched mantle domains trapped in collisional setting may not be completely ruled out.

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[3] Balica, C., Stremtan, C., Balintoni, I. Post-collisional late Variscan magmatism in the Danubian Domain (South Carpathians, Romania) documented by zircon U/Pb LA-ICP-MS. (in prep.)